(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 535 626 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
19.12.2012 Bulletin 2012/51

(21) Application number: **10845813.4**

(22) Date of filing: **14.12.2010**

(51) Int Cl.:
F16K 31/06 *(2006.01)* ***H01F 7/127*** *(2006.01)*
H01F 7/16 *(2006.01)*

(86) International application number:
PCT/JP2010/072446

(87) International publication number:
WO 2011/099223 (18.08.2011 Gazette 2011/33)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **12.02.2010 JP 2010028509**

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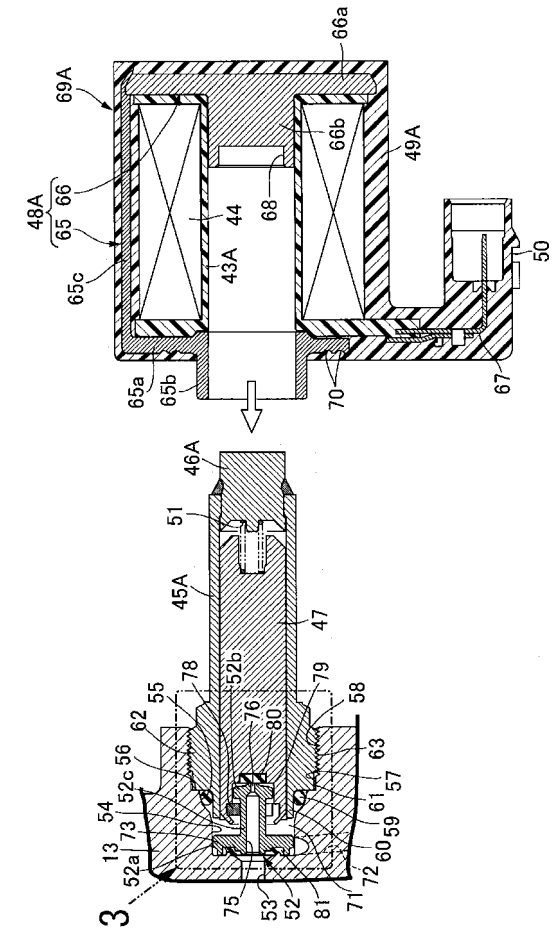
(54) SOLENOID DEVICE

(57) A solenoid device is provided in which a male thread (63) provided on an outer periphery of a guide tube (45A) is screwed into a threaded hole (58) provided in a body (13) to fix the guide tube (45A) to the body (13), and a coil-side assembled unit (69A) formed by assembling in advance a bobbin (43A), a coil (44), a magnetic frame (48A), and a cover portion (49A) is fixed to the guide tube (45A) by press fitting the guide tube (45A) or a fixed core (46A) fixed to the guide tube (45A) into the magnetic frame (48A). Thus, the assembly of a bobbin, a coil, a cover portion integrally having a coupler part, and a magnetic frame onto a guide tube can be carried out with enhanced workability by means of a structure having fewer components and low cost, and the position of the coupler part in the peripheral direction of the guide tube can be easily and freely set.

[Fig. 2]



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Description

TECHNICAL FIELD

[0001] The present invention relates to a solenoid device that includes a bobbin, a coil that is wound around the bobbin, a guide tube that is made of a non-magnetic material, has one end part fixed to a body, and is inserted into the bobbin, a fixed core that is fixed to the guide tube so as to block the other end of the guide tube, a plunger that is slidably fitted into the guide tube so as to oppose the fixed core, a magnetic frame that covers at least the bobbin and the coil and provides a magnetic connection between the fixed core and the plunger, and a cover portion that is made of a synthetic resin, covers the bobbin and the coil, and integrally has a coupler part projecting outwardly from the magnetic frame.

BACKGROUND ART

[0002] A solenoid device in which a coil assembly is formed by covering a bobbin and a coil wound around the bobbin with a synthetic resin cover portion, a guide tube, which has one end part fixed to a body and has secured to the other end part a fixed core integrally provided with a threaded shaft, is fitted into the bobbin, the coil assembly is then covered by a bottomed cylindrical solenoid housing that forms part of a magnetic frame and is provided with an insertion hole in a blocking end wall so that the threaded shaft is inserted through the insertion hole, and the coil assembly and the magnetic frame are assembled around the guide tube by screwing a cap nut on the threaded shaft so that a washer is disposed between the cap nut and an outer face of the blocking end wall of the solenoid housing, is disclosed in for example Patent Document 1.

RELATED ART DOCUMENT

PATENT DOCUMENT

[0003]

Patent Document 1: Japanese Patent Application Laid-open No. 11-270729

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] In the solenoid device disclosed in Patent Document 1 above, since the coil assembly and the solenoid housing are assembled in sequence on the guide tube fixed to the body, and the cap nut is tightened via the washer, it cannot be said that the ease of operation is excellent, and the mass productivity is low. Moreover, the washer and the cap nut are required, and the number of components increases. Furthermore, it is necessary to carry out threading of the threaded shaft, thereby resulting in an increase in machining cost.

[0005] The coupler part, which is integrally provided with the cover portion, projects outwardly from a cutout part provided in a side wall of the solenoid housing; in order to prevent an undesired external force from acting on a conducting wire connected to the coupler part, it is necessary for the position of the coupler part along the peripheral direction of the solenoid housing to be at a fixed position when assembled on the body. On the other hand, in a device in which the center of a blocking end wall of a bottomed cylindrical solenoid housing is secured to a fixed core, increasing the tightening strength enables the position of the cutout part of the solenoid housing, that is, the coupler part, along the peripheral direction of the guide tube to be fixed, but it is necessary to increase the strength of the solenoid housing, the fixed core, etc. around the securing part. In the arrangement disclosed in Patent Document 1 above, an engagement claw provided on the solenoid housing is engaged with a restricting wall provided on the body side so as to eliminate the necessity for increasing the tightening strength and prevents the coupler part from being displaced from a fixed position along the peripheral direction of the guide tube, but it becomes necessary to employ the restricting wall and the engagement claw, thus making the structure complicated. Furthermore, when changing the position at which the coupler part is disposed, it is necessary to change the position, relative to the engagement claw for engaging with the restricting wall, of the cutout part through which the coupler part projects outwardly in the solenoid housing, and a plurality of types of solenoid housings are required.

[0006] The present invention has been accomplished in light of such circumstances, and it is an object thereof to provide a solenoid device that enables the assembly of a bobbin, a coil, a cover portion integrally having a coupler part, and a magnetic frame onto a guide tube to be carried out with enhanced workability by means of a structure having fewer components and low cost, and that enables the position of the coupler part in the peripheral direction of the guide tube to be easily and freely set.

MEANS FOR SOLVING THE PROBLEMS

[0007] In order to achieve the above object, according to a first aspect of the present invention, there is provided a solenoid device comprising a bobbin, a coil that is wound around the bobbin, a guide tube that is made of a non-magnetic material, has one end part fixed to a body, and is inserted into the bobbin, a fixed core that is fixed to the guide tube so as to block the other end of the guide tube, a plunger that is slidably fitted into the guide tube so as to oppose the fixed core, a magnetic frame that covers at least the bobbin and the coil and provides a magnetic connection between the fixed core and the plunger, and a cover portion that is made of a synthetic

resin, covers the bobbin and the coil, and integrally has a coupler part projecting outwardly from the magnetic frame, characterized in that a male thread provided on an outer periphery of the guide tube or a male thread provided on an outer periphery of a cylindrical holder holding the guide tube between the holder and the body is screwed into a threaded hole provided in the body so as to fix the guide tube to the body, and a coil-side assembled unit formed by assembling in advance the bobbin, the coil, the magnetic frame and the cover portion is fixed to the guide tube by press fitting the guide tube or the fixed core fixed to the guide tube into the magnetic frame.

[0008] Further, in order to attain the above object, according to a second aspect of the present invention, there is provided a solenoid device comprising a bobbin, a coil that is wound around the bobbin, a guide tube that is made of a non-magnetic material, has one end part fixed to a body, and is inserted into the bobbin, a fixed core that is fixed to the guide tube so as to block the other end of the guide tube, a plunger that is slidably fitted into the guide tube so as to oppose the fixed core, a magnetic frame that covers at least the bobbin and the coil and provides a magnetic connection between the fixed core and the plunger, and a cover portion that is made of a synthetic resin, covers the bobbin and the coil, and integrally has a coupler part projecting outwardly from the magnetic frame, characterized in that a threaded hole is provided in the body, a male thread provided on an outer periphery of a cylindrical holder holding the guide tube between the holder and the body while forming between the holder and the outer periphery of the guide tube an annular gap opening outwardly in an axial direction or a male thread provided on the outer periphery of the guide tube having an annular recess coaxially disposed in a radially inward direction of the threaded hole and opening outwardly in an axial direction is screwed into the threaded hole so as to fix the guide tube to the body, and a coil-side assembled unit formed by assembling in advance the bobbin, the coil, the magnetic frame and the cover portion is fixed to the guide tube by press fitting an outer periphery of a cylindrical magnetic flux transfer portion forming part of the magnetic frame while coaxially surrounding part of the guide tube that projects from the bobbin toward the body into an inner periphery of the holder within the annular gap or press fitting the outer periphery of the magnetic flux transfer portion into the guide tube within the annular recess.

[0009] In order to attain the above object, according to a third aspect of the present invention, there is provided a solenoid device comprising a bobbin, a coil that is wound around the bobbin, a guide tube that is made of a non-magnetic material, has one end part fixed to a body, and is inserted into the bobbin, a fixed core that is fixed to the guide tube so as to block the other end of the guide tube, a plunger that is slidably fitted into the guide tube so as to oppose the fixed core, a magnetic frame that covers at least the bobbin and the coil and provides a magnetic connection between the fixed core and the plunger, and a cover portion that is made of a synthetic resin, covers the bobbin and the coil, and integrally has a coupler part projecting outwardly from the magnetic frame, characterized in that a threaded hole is provided in the body, a male thread provided on an outer periphery of a cylindrical holder holding the guide tube between the holder and the body while forming between the holder and an outer periphery of the guide tube an annular gap opening outwardly in an axial direction or a male thread provided on an outer periphery of the guide tube having an annular recess coaxially disposed in a radially inward direction of the threaded hole and opening outwardly in an axial direction is screwed into the threaded hole so as to fix the guide tube to the body, and a coil-side assembled unit formed by assembling in advance the bobbin, the coil, the magnetic frame and the cover portion is fixed to the guide tube by press fitting the guide tube or the fixed core fixed to the guide tube into the magnetic frame while inserting into the annular gap or the annular recess a cylindrical magnetic flux transfer portion forming part of the magnetic frame while coaxially surrounding part of the guide tube that projects from the bobbin toward the body.

[0010] According to a fourth aspect of the present invention, in addition to the second or third aspect, an annular step that is disposed further inward in the axial direction than the threaded hole is provided on the body so as to face outward in the axial direction, and a flange part sandwiched between the annular step and the holder is integrally provided with an end part, on the body side, of the guide tube so as to protrude outwardly in the radial direction.

[0011] According to a fifth aspect of the present invention, in addition to any one of the first to fourth aspects, the cover portion of the coil-side assembled unit is formed so as to cover the bobbin and the coil and also covers that part of the magnetic frame that covers the bobbin and the coil.

[0012] According to a sixth aspect of the present invention, in addition to any one of the first to fourth aspects, the coil-side assembled unit is formed from a coil assembly that is formed by covering the bobbin and the coil with a cover portion having the coupler part formed integrally therewith, and the magnetic frame that is formed by joining to each other at least two magnetic frame members covering the coil assembly in cooperation, the at least two magnetic frame members being joined to each other by means of swaging or press fitting.

[0013] According to a seventh aspect of the present invention, in addition to any one of the first to sixth aspects, a labyrinth groove is provided on a face of the magnetic frame or the bobbin that faces the cover portion.

[0014] Further, according to an eighth aspect of the present invention, in addition to any one of the first to seventh aspects, the entirety of the bobbin and the coil wound around the bobbin is covered by the cover portion.

EFFECTS OF THE INVENTION

[0015] In accordance with the first aspect of the present invention, the guide tube is fixed to the body by screwing into the threaded hole of the body the male thread on the outer periphery of the guide tube or the outer periphery of the cylindrical holder holding the guide tube between itself and the body, the coil-side assembled unit formed by assembling in advance the bobbin, the coil, the magnetic frame, and the cover portion is fixed to the guide tube by press fitting the guide tube or the fixed core fixed to the guide tube into the magnetic frame of the coil-side assembled unit, it is therefore unnecessary to employ a special component for fixing or to carry out special machining when assembling onto the guide tube the bobbin, the coil, the cover portion integrally having the coupler part, and the magnetic frame, and it becomes possible to carry out assembly with enhanced workability by means of a structure having fewer components and low cost. Furthermore, the position of the coupler part in the peripheral direction of the guide tube can be set freely and easily only by determining it when press fitting the guide tube or the fixed core into the magnetic frame, and the position of the coupler part will not deviate from the set position.

[0016] In accordance with the second aspect of the present invention, the guide tube is fixed to the body by screwing into the threaded hole of the body the male thread on the outer periphery of the cylindrical holder holding the guide tube between itself and the body while forming the annular gap between itself and the outer periphery of the guide tube or screwing into the threaded hole the male thread on the outer periphery of the guide tube having the annular recess disposed coaxially in the radially inward direction of the threaded hole and opening outwardly in the axial direction, the coil-side assembled unit formed by assembling in advance the bobbin, the coil, the magnetic frame, and the cover portion is fixed to the guide tube by press fitting the cylindrical magnetic flux transfer portion forming part of the magnetic frame into the inner periphery of the holder within the annular gap or press fitting the outer periphery of the magnetic flux transfer portion into the guide tube within the annular recess, it is therefore unnecessary to employ a special component for fixing or to carry out special machining when assembling onto the guide tube the bobbin, the coil, the cover portion integrally having the coupler part, and the magnetic frame, and it becomes possible to carry out assembly with enhanced workability by means of a structure having fewer components and low cost. Furthermore, the position of the coupler part in the peripheral direction of the guide tube can be set freely and easily only by determining it when press fitting the magnetic flux transfer portion into the holder or the guide tube, and the position of the coupler part will not deviate from the set position. Moreover, providing the magnetic flux transfer portion enables the area of the magnetic path between the magnetic frame and the plunger to be increased, thereby increasing the attractive force of the fixed core acting on the plunger. Furthermore, since the magnetic flux transfer portion is inserted into the annular gap or the annular recess, any increase in the axial length of the solenoid device due to the magnetic flux transfer portion being provided on the magnetic frame can be suppressed; moreover, it is unnecessary to take into consideration deformation of the guide tube, into which the plunger is fitted, when press fitting the magnetic flux transfer portion into the inner periphery of the holder, and the slide gap between the guide tube and the plunger can be set small.

[0017] In accordance with the third aspect of the present invention, the guide tube is fixed to the body by screwing into the threaded hole of the body the male thread on the outer periphery of the cylindrical holder holding the guide tube between itself and the body while forming the annular gap between itself and the outer periphery of the guide tube or screwing into the threaded hole the male thread on the outer periphery of the guide tube having the annular recess disposed coaxially in the radially inward direction of the threaded hole and opening outwardly in the axial direction, the coil-side assembled unit formed by assembling in advance the bobbin, the coil, the magnetic frame, and the cover portion is fixed to the guide tube by press fitting the guide tube or the fixed core fixed to the guide tube into the magnetic frame of the coil-side assembled unit, it is therefore unnecessary to employ a special component for fixing or to carry out special machining when assembling onto the guide tube the bobbin, the coil, the cover portion integrally having the coupler part, and the magnetic frame, and it becomes possible to carry out assembly with enhanced workability by means of a structure having fewer components and low cost. Furthermore, the position of the coupler part in the peripheral direction of the guide tube can be set freely and easily only by determining it when press fitting the guide tube or the fixed core into the magnetic frame, and the position of the coupler part will not deviate from the set position. Moreover, providing the magnetic flux transfer portion enables the area of the magnetic path between the magnetic frame and the plunger to be increased, thereby increasing the attractive force of the fixed core acting on the plunger. Furthermore, since the magnetic flux transfer portion is inserted into the annular gap or the annular recess, any increase in the axial length of the solenoid device due to the magnetic flux transfer portion being provided on the magnetic frame can be suppressed.

[0018] In accordance with the fourth aspect of the present invention, since the flange part integrally provided with the end part, on the body side, of the guide tube and protruding in the radially outward direction is held between the annular step of the body and the holder, it is possible to easily form the annular gap between the holder and the guide tube.

[0019] In accordance with the fifth aspect of the present invention, since the cover portion is formed so as to cover

the bobbin and the coil and also cover that portion of the magnetic frame that covers the bobbin and the coil, the mass productivity of the coil-side assembled unit can be enhanced by making the bobbin, the coil, the magnetic frame, and the cover portion into a unit, and since that portion of the magnetic frame that covers the bobbin and the coil is covered by the cover portion, it is possible to make the magnetic frame resistant to rusting.

[0020] In accordance with the sixth aspect of the present invention, since the coil-side assembled unit is formed by covering the coil assembly, which is formed by covering the bobbin and the coil by the cover portion integrally having the coupler part, with at least two magnetic frame members in cooperation, the magnetic frame members being joined to each other by swaging or press fitting so as to form the magnetic frame, compared with an arrangement in which part of the magnetic frame is covered by the cover portion, a mold for forming the cover portion can have a simple structure.

[0021] In accordance with the seventh aspect of the present invention, since the labyrinth groove is provided on a face of the magnetic frame or the bobbin that faces the cover portion, it is possible to inhibit water from infiltrating into the coil side without a seal member such as an O ring being disposed between the cover portion and the magnetic frame or the bobbin.

[0022] Furthermore, in accordance with the eighth aspect of the present invention, since the entirety of the bobbin and the coil is covered by the cover portion, it is possible to reliably inhibit water from infiltrating into the coil side without a seal member such as an O ring being disposed between the bobbin and the cover portion.

BRIEF DESCRIPTION OF DRAWINGS

[0023]

[FIG. 1] FIG. 1 is a vertical sectional view of a decompression valve of Embodiment 1. (first embodiment)

[FIG. 2] FIG. 2 is an enlarged exploded vertical sectional view of an electromagnetic cut-off valve. (first embodiment)

[FIG. 3] FIG. 3 is an enlarged view of the part shown by arrow 3 in FIG. 2. (first embodiment)

[FIG. 4] FIG. 4 is a sectional view, corresponding to FIG. 3, of Embodiment 2. (second embodiment)

[FIG. 5] FIG. 5 is a vertical sectional view of an electromagnetic cut-off valve of Embodiment 3. (third embodiment)

[FIG. 6] FIG. 6 is an exploded vertical sectional view of the electromagnetic cut-off valve of FIG. 5. (third embodiment)

[FIG. 7] FIG. 7 is a vertical sectional view of a coil-side assembled unit of Embodiment 4. (fourth embodiment)

[FIG. 8] FIG. 8 is an exploded vertical sectional view of the coil-side assembled unit of FIG. 7. (fourth embodiment)

[FIG. 9] FIG. 9 is a vertical sectional view of a coil-side assembled unit of Embodiment 5. (fifth embodiment)

[FIG. 10] FIG. 10 is a vertical sectional view of an electromagnetic cut-off valve of Embodiment 6. (sixth embodiment)

EXPLANATION OF REFERENCE NUMERALS AND SYMBOLS

[0024]

13 Body
43A, 43B, 43C Bobbin
44 Coil
45A, 45B, 45C Guide tube
46A, 46B Fixed core
47 Plunger
48A, 48B Magnetic frame
49A, 49B, 49C, 49D Cover portion
50 Coupler part
58, 89 Threaded hole
63, 85, 96, 123 Male thread
69A, 69B, 69C, 69D Coil-side assembled unit
70, 110, 111, 112, 113 Labyrinth groove
84, 95 Holder
90 Annular step
94 Flange part
98 Annular gap
103, 104 Magnetic frame member
103b Magnetic flux transfer portion
116 Coil assembly
124 Annular recess

MODES FOR CARRYING OUT THE INVENTION

[0025] Modes for carrying out the present invention are explained below by reference to the attached drawings.

EMBODIMENT 1

[0026] Embodiment 1 of the present invention is explained by reference to FIG. 1 to FIG. 3; first, in FIG. 1, this decompression valve for a gas is for decompressing compressed natural gas and supplying it to an engine (not illustrated) and includes a body 13 that has in a central part a vertically extending housing hole 12 having in an intermediate part an inward collar 11 protruding in a radially inward direction, and a diaphragm cover 14 that is formed by press forming thin metal and is joined to the body 13, the body 13 housing a valve mechanism 15 and being provided with a relief valve 16 and an electromagnetic cut-off valve 17A, which is a solenoid device.

[0027] The valve mechanism 15 is housed in the housing hole 12 beneath the inward collar 11 so that it is driven by a diaphragm 18, and has a guide member 20 that is made of metal and gas-tightly fitted into the housing hole

12, a valve seat member 21 that liquid-tightly abuts against the inward collar 11 from below and is joined to the guide member 20 while forming a valve chamber 22 between itself and the guide member 20 and that is provided with a valve seat 24 having a valve hole 23 in its central part and facing the valve chamber 22, a valve shaft 25 that is slidably fitted into the guide member 20 while loosely extending through the valve hole 23, and a valve body 26 that is made of a synthetic resin and fitted around the outer periphery of the valve shaft 25 within the valve chamber 22 so that it can be seated on the valve seat 24.

[0028] An annular high-pressure chamber 28 is formed between the guide member 20 and valve seat member 21 and the body 13, the high-pressure chamber 28 communicating with the valve chamber 22 via a filter 27 held between the guide member 20 and the valve seat member 21, a decompression chamber 29 communicating with the valve hole 23 is formed in an upper part of the body 13, and the valve mechanism 15 is housed in the housing hole 12 so as to be disposed between the high-pressure chamber 28 and the decompression chamber 29.

[0029] Screwed into the housing hole 12 is a ring-shaped retaining member 30 that abuts against the guide member 20 from below so as to hold the guide member 20 and the valve seat member 21 between itself and the inward collar 11, and by screwing this retaining member 30 into the housing hole 12 the valve mechanism 15 is fixedly housed within the housing hole 12.

[0030] An adjustment member 31 is gas-tightly screwed into the housing hole 12 at a position spaced downwardly from the retaining member 30, the adjustment member 31 being capable of changing its back and forth position along the axial direction. Furthermore, one end part of the valve shaft 25 gas-tightly and slidably extends through the guide member 20, and a back coil spring 33 is provided in a compressed state between the adjustment member 31 and a spring-bearing member 32 fitted on the one end of the valve shaft 25. Adjusting the back and forth position in the axial direction of the adjustment member 31 by rotating the adjustment member 31 enables the spring load of the back coil spring 33 to be adjusted.

[0031] A back pressure chamber 34 is formed between the adjustment member 31 and the body 13 and guide member 20, the one end part of the valve shaft 25 extending to the back pressure chamber 34, and a passage groove 35 is provided on the outer periphery of the valve shaft 25, the passage groove 35 providing communication between the back pressure chamber 34 and the decompression chamber 29.

[0032] A linking member 36 is gas-tightly and slidably fitted into an upper part of the housing hole 12, the other end part of the valve shaft 25 being linked to the linking member 36, and the linking member 36 is linked to a central part of the diaphragm 18, whose peripheral edge part is held between the upper part of the body 13 and the diaphragm cover 14.

[0033] A pressure action chamber 38 communicating with the decompression chamber 29 via a through passage 37 provided in the body 13 is formed between the diaphragm 18 and the body 13, one face of the diaphragm 18 facing the pressure action chamber 38, and a spring chamber 39 is formed between the diaphragm 18 and the diaphragm cover 14, the other face of the diaphragm 18 facing the spring chamber 39. Moreover, a coil-shaped diaphragm spring 40 housed in the spring chamber 39 is provided in a compressed state between the diaphragm cover 14 and the diaphragm 18. Furthermore, a negative-pressure introducing pipe 41 communicating with the spring chamber 39 is connected to the diaphragm cover 14, this negative-pressure introducing pipe 41 is connected to an engine, and intake negative pressure of the engine is introduced into the spring chamber 39.

[0034] In such a valve mechanism 15, when the diaphragm 18 flexes toward the spring chamber 39 side against the spring force of the diaphragm spring 40 due to the pressure of the pressure action chamber 38, the valve mechanism 15 closes, and when the diaphragm 18 flexes toward the pressure action chamber 38 side due to a decrease in the pressure of the pressure action chamber 38, the valve mechanism 15 opens; repeating such opening and closing of the valve mechanism 15 allows high pressure compressed natural gas from the high-pressure chamber 28 to be decompressed and guided to the decompression chamber 29.

[0035] An outlet passage (not illustrated) communicating with the decompression chamber 29 is provided in the body 13. Furthermore, the relief valve 16 is opened when the pressure of the decompression chamber 29 exceeds a predetermined pressure to thus release part of the pressure to the outside, and is disposed on the body 13 so as to be connected to the decompression chamber 29.

[0036] The electromagnetic cut-off valve 17A includes a bobbin 43A that is formed from a synthetic resin, a coil 44 that is wound around the bobbin 43A, a guide tube 45A that is made of a non-magnetic material, has one end part fixed to the body 13, and is inserted into the bobbin 43A, a fixed core 46A that blocks the other end of the guide tube 45A and is secured to the guide tube 45A, a plunger 47 that opposes the fixed core 46A and is slidably fitted into the guide tube 45A, a magnetic frame 48A that is made of a magnetic metal, covers at least the bobbin 43A and the coil 44, and provides a magnetic connection between the fixed core 46A and the plunger 47, a cover portion 49A that is made of a synthetic resin, covers the bobbin 43A and the coil 44, and integrally has a coupler part 50 projecting outwardly from the magnetic frame 48A, a return spring 51 provided between the fixed core 46A and the plunger 47, and a valve member 52 retained on the plunger 47 on the side opposite to the fixed core 46A.

[0037] Referring in addition to FIG. 2 and FIG. 3, coaxially provided in the body 13 are a communication hole

53 that has its inner end communicating with the high-pressure chamber 28, a main valve chamber-forming hole 54 that has a larger diameter than the communication hole 53 and communicates with the outer end of the communication hole 53, an annular inclined face 55 that, while increasing in diameter in going outward in the axial direction, is connected to the outer end of the main valve chamber-forming hole 54, an annular step 56 that is connected to the outer end of the annular inclined face 55 and faces outward in the axial direction, a fitting hole 57 that extends from the outer periphery of the annular step 56 outwardly in the axial direction, and a threaded hole 58 that has a larger diameter than the fitting hole 57 and is connected to the outer end of the fitting hole 57.

[0038] Referring in addition to FIG. 3, provided on the one end part of the guide tube 45A are a small diameter cylindrical part 60 that has an annular seal member 59 disposed between itself and the annular inclined face 55, a fitting tubular part 61 that is formed so as to have a larger diameter than the small diameter cylindrical part 60 so as to be fitted into the fitting hole 57 and abut against the annular step 56, a screw-in tubular part 62 that is formed so as to have a larger diameter than the fitting tubular part 61 and has a male thread 63 cut on the outer periphery, the male thread 63 being screwed into the threaded hole 58, and a tool engagement portion 64 that has a non-circular cross section and with which a tool is engaged so as to rotate the guide tube 45A, the one end part of the guide tube 45A being fixed to the body 13 by screwing the male thread 63 on the outer periphery into the threaded hole 58.

[0039] The magnetic frame 48A is formed from a first magnetic frame member 65 that covers one end, in the axial direction, of the bobbin 43A and the outer periphery of the coil 44, and a second magnetic frame member 66 that covers the other end, in the axial direction, of the bobbin 43A.

[0040] The first magnetic frame member 65 integrally has a ring plate-shaped first end plate portion 65a that abuts against an outer face of the one end in the axial direction of the bobbin 43A, a cylindrical magnetic flux transfer portion 65b that is connected to the inner periphery of the first end plate portion 65a and surrounds part of the outer periphery of the guide tube 45A, and a cylindrical outer frame portion 65c that has one end connected to the outer periphery of the first end plate portion 65a and covers the bobbin 43A and the outer periphery of the coil 44, and the outer frame portion 65c is provided with a cutout part for the coupler part 50 to project outwardly from the outer frame portion 65c, the coupler part 50 being formed integrally with the cover portion 49A while making terminal plates 67 extending outwardly from the one end of the bobbin 43A extend to the coupler part 50.

[0041] The second magnetic frame member 66 is formed so as to integrally have a ring plate-shaped second end plate portion 66a that abuts against the other end of the bobbin 43A and a fitting projection 66b that is projectingly provided in the center of the second end plate portion 66a so as to be fitted into the other end part of the bobbin 43A, the fitting projection 66b being provided with a fitting recess 68.

[0042] The other end of the outer frame portion 65c of the first magnetic frame member 65 is joined by swaging to the outer periphery of the second end plate portion 66a of the second magnetic frame member 66, but since the cover portion 49A makes the first and second magnetic frame members 65 and 66 into a unit, it is not always necessary to join the first and second magnetic frame members 65 and 66 by swaging.

[0043] The fixed core 46A is formed from a magnetic metal into a rod shape having a circular cross section, and is secured to the guide tube 45A by welding, etc. in a state in which one end part thereof is fitted into the other end part of the guide tube 45A while the outer end thereof projects from the other end of the guide tube 45A, and the other end part of this fixed core 46A is fitted into the fitting recess 68.

[0044] The bobbin 43A, the coil 44 wound around the bobbin 43A, the magnetic frame 48A, and the cover portion 49A form a coil-side assembled unit 69A by assembling these 43A, 44, 48A, and 49A in advance, and this coil-side assembled unit 69A is fixed to the guide tube 45A.

[0045] Moreover, the cover portion 49A is formed so as to cover the bobbin 43A and the coil 44 and also cover that portion of the magnetic frame 48A that covers the bobbin 43A and the coil 44, and in Embodiment 1 the coil-side assembled unit 69A is formed by covering the bobbin 43A, the coil 44, and the magnetic frame 48A with the cover portion 49A except for part of the magnetic flux transfer portion 65b.

[0046] The coil-side assembled unit 69A is fixed to the guide tube 45A by press fitting the guide tube 45A fixed to the body 13 into the magnetic flux transfer portion 65b of the magnetic frame 48A.

[0047] Furthermore, of the first magnetic frame member 65 of the magnetic frame 48A, part of the magnetic flux transfer portion 65b protrudes from the cover portion 49A; in order to inhibit water that has infiltrated via a gap formed between the cover portion 49A and the outer periphery of the magnetic flux transfer portion 65b from flowing toward the coil 44 wound around the bobbin 43A, a plurality of annular labyrinth grooves 70 are provided on a face, that faces the cover portion 49A, of the first end plate portion 65a of the first magnetic frame member 65.

[0048] Due to the guide tube 45A being fixed to the body 13 in a state in which the one end part thereof is inserted into the main valve chamber-forming hole 54 and the plunger 47 being slidably fitted into the guide tube 45A, a main valve chamber 71 is formed between the body 13 and one end of the guide tube 45A and plunger 47. Moreover, the body 13 is provided with an inlet passage 72 communicating with the main valve chamber 71, high pressure gas being introduced into the main valve chamber 71.

[0049] The body 13 is also provided with an annular valve seat 73 projecting slightly toward the main valve chamber 71 side so as to surround an end, opening to the main valve chamber 71, of the communication hole 53 communicating with the high-pressure chamber 28.

[0050] The valve member 52 is formed by integrally connecting a main valve portion 52a on one end side and a pilot valve portion 52b on the other end side via a linking tubular part 52c that forms a step between the valve portions 52a and 52b, the main valve portion 52a being formed into a disc shape movably housed in the main valve chamber-forming hole 54, the pilot valve portion 52b being formed into a disc shape having as one end face a tapered face 74 having a diameter that decreases in going toward the plunger 47 side, and the diameter of the pilot valve portion 52b being set smaller than the diameter of the main valve portion 52a. Coaxially provided in a central part of the valve member 52 are a first passage 75 always communicating with the communication hole 53 and a second passage 76 communicating with the first passage 75 and opening in a central part on the one end face of the pilot valve portion 52b, the second passage 76 being formed with a smaller diameter than that of the first passage 75.

[0051] An end part of the plunger 47 that faces the main valve chamber 71 is provided with a recess 77 for the pilot valve portion 52b to be inserted into, the pilot valve portion 52b is loosely inserted into the recess 77 so as to be prevented from escaping from the recess 77 by means of a C-shaped retaining ring 78 fixed to the other end of the plunger 47, and a pilot valve chamber 79 communicating with the main valve chamber 71 is formed between the pilot valve portion 52b and the plunger 47. Furthermore, a rubber seal 80 that blocks an opening of the second passage 76 to the pilot valve chamber 79 when the central part of the end face of the pilot valve portion 52b is seated is embedded in a central part of a closed end of the recess 77. The retaining ring 78 is thus fixed to the plunger 47 at a position at which the pilot valve portion 52b can move in the axial direction relative to the plunger 47 between the retaining ring 78 and the closed end of the recess 77.

[0052] Also embedded in the main valve portion 52a is an annular rubber seal 81 that blocks communication between the main valve chamber 71 and the communication hole 53 by being seated on the valve seat 73.

[0053] In such an electromagnetic cut-off valve 17A, when the engine is stopped, due to de-energization of the coil 44 the plunger 47 is moved in a direction away from the fixed core 46A by means of the spring force of the return spring 51, the rubber seal 81 of the main valve portion 52a is seated on the valve seat 73 to thus block communication between the main valve chamber 71 and the communication hole 53, and at the same time the pilot valve portion 52b is seated on the rubber seal 80 to thus block communication between the pilot valve chamber 79 and the communication hole 53, thereby stopping the supply of high pressure gas toward the high-pressure chamber 28 side.

[0054] On the other hand, when the engine starts running and the coil 44 is energized, first the plunger 47 moves toward the fixed core 46A side only by an amount that detaches the pilot valve portion 52b from the rubber seal 80, and the second passage 76 communicating with the communication hole 53 via the first passage 75 communicates with the pilot valve chamber 79. This allows high pressure gas to gradually flow from the main valve chamber 71 to the communication hole 53 via the pilot valve chamber 79, the second passage 76, and the first passage 75, thereby making the difference between the pressure acting on the main valve portion 52a from the main valve chamber 71 side and that from the communication hole 53 side small. When the electromagnetic force due to the coil 44 overcomes the difference in pressure acting on the main valve portion 52a, the plunger 47 moves further toward the fixed core 46A side, the rubber seal 81 of the main valve portion 52a detaches from the valve seat 73, and high pressure gas flows from the main valve chamber 71 to the communication hole 53.

[0055] The operation of Embodiment 1 is now explained. The guide tube 45A is fixed to the body 13 by screwing into the threaded hole 58 provided in the body 13 the male thread 63 provided on the outer periphery of the one end part of the guide tube 45A, and the coil-side assembled unit 69A formed by assembling in advance the bobbin 43A, the coil 44, the magnetic frame 48A, and the cover portion 49A is fixed to the guide tube 45A by press fitting the guide tube 45A into the magnetic flux transfer portion 65b of the magnetic frame 48A; it is therefore unnecessary to employ a special component for fixing or to carry out special machining when assembling onto the guide tube 45A the bobbin 43A, the coil 44, the cover portion 49A integrally having the coupler part 50, and the magnetic frame 48A, and it becomes possible to carry out assembly with enhanced workability by means of a structure having fewer components and low cost. Furthermore, the position of the coupler part 50 in the peripheral direction of the guide tube 45A can be set freely and easily only by determining it when press fitting the guide tube 45A into the magnetic flux transfer portion 65b of the magnetic frame 48A, and the position of the coupler part 50 will not deviate from the set position.

[0056] Furthermore, since the cover portion 49A of the coil-side assembled unit 69A is formed so as to cover the bobbin 43A and the coil 44 and also cover that portion of the magnetic frame 48A that covers the bobbin 43A and the coil 44, the mass productivity of the coil-side assembled unit 69A can be enhanced by making the bobbin 43A, the coil 44, the magnetic frame 48A, and the cover portion 49A into a unit, and since that portion of the magnetic frame 48A that covers the bobbin 43A and the coil 44 is covered by the cover portion 49A, it is possible to make the magnetic frame 48A resistant to rusting.

[0057] Moreover, part of the magnetic flux transfer portion 65b of the first magnetic frame member 65 of the magnetic frame 48A projects from the cover portion 49A;

since the plurality of annular labyrinth grooves 70 are provided on the face, facing the cover portion 49A, of the first end plate portion 65a of the first magnetic frame member 65, it is possible for the labyrinth grooves 70 to inhibit water that has infiltrated through the gap formed between the cover portion 49A and the outer periphery of the magnetic flux transfer portion 65b from flowing toward the coil 44 wound around the bobbin 43A, and it becomes unnecessary for a seal member to be disposed between the first end plate portion 65a and the cover portion 49A, thereby contributing to a reduction in the number of components.

[0058] Embodiment 1 above has a structure in which the coil-side assembled unit 69A is fixed to the guide tube 45A by press fitting the guide tube 45A into the magnetic flux transfer portion 65b of the magnetic frame 48A, but it can have a structure in which the coil-side assembled unit 69A is fixed to the guide tube 45A by press fitting the fixed core 46A fixed to the guide tube 45A into the fitting recess 68 provided in the fitting projection 66b of the second magnetic frame member 66 of the magnetic frame 48A.

EMBODIMENT 2

[0059] Embodiment 2 of the present invention is explained by reference to FIG. 4; parts corresponding to those of Embodiment 1 are denoted by the same reference numerals and symbols and are only illustrated, detailed explanation thereof being omitted.

[0060] A flange part 83 is provided integrally with one end part of a guide tube 45B, the flange part 83 protruding radially outwardly so as to abut against the annular step 56 while being fitted into a fitting hole 57 provided in the body 13, a male thread 85, which is screwed into the threaded hole 58, is cut on the outer periphery of a cylindrical holder 84 surrounding the one end part of the guide tube 45B, and a tool engagement portion 84a having a non-circular cross section and having a tool engaged therewith for rotating the holder 84 is provided on the outer end of the holder 84.

[0061] By screwing the male thread 85 of the holder 84 holding the flange part 83 between itself and the annular step 56 into the threaded hole 58 and tightening, the guide tube 45B is fixed to the body 13.

[0062] In accordance with Embodiment 2 also, the same effects as those of Embodiment 1 above can be exhibited.

EMBODIMENT 3

[0063] Embodiment 3 of the present invention is explained by reference to FIG. 5 and FIG. 6; parts corresponding to those of Embodiment 1 are denoted by the same reference numerals and symbols and are only illustrated, detailed explanation thereof being omitted.

[0064] First, in FIG. 5, an electromagnetic cut-off valve 17B includes a bobbin 43B made of a synthetic resin, a coil 44 wound around the bobbin 43B, a guide tube 45C made of a non-magnetic material and having one end part fixed to a body 13 and inserted into the bobbin 43B, a fixed core 46B fixed to the guide tube 45C so as to block the other end of the guide tube 45C, a plunger 47 slidably fitted into the guide tube 45C so as to oppose the fixed core 46B, a magnetic frame 48B made of a magnetic metal and covering at least the bobbin 43B and the coil 44 so as to provide a magnetic connection between the fixed core 46B and the plunger 47, a cover portion 49B made of a synthetic resin, covering the bobbin 43B and the coil 44, and integrally having a coupler part 50 projecting outwardly from the magnetic frame 48B, a return spring 51 provided between the fixed core 46B and the plunger 47, and a valve member 52 retained on the plunger 47 on the side opposite to the fixed core 46B.

[0065] Referring in addition to FIG. 6, coaxially provided in the body 13 are a communication hole 53 having its inner end communicating with the high-pressure chamber 28 (see Embodiment 1), a main valve chamber-forming hole 54 formed so as to have a larger diameter than that of the communication hole 53 and communicating with the outer end of the communication hole 53, a fitting hole 88 having a larger diameter than that of the main valve chamber-forming hole 54 and connected to the outer end of the main valve chamber-forming hole 54, and a threaded hole 89 having a larger diameter than that of the fitting hole 88 and connected to the outer end of the fitting hole 88. Furthermore, a first annular step 90 facing outward in the axial direction is formed between the main valve chamber-forming hole 54 and the fitting hole 88, a second annular step 91 facing outward in the axial direction is formed between the fitting hole 88 and the threaded hole 89, and a ring groove 93 is provided in the first annular step 90, an O ring 92 being fitted into the ring groove 93.

[0066] A flange part 94 is provided at one end part of the guide tube 45C so as to protrude radially outward, the flange part 94 being fitted into the fitting hole 88 so that the O ring 92 is disposed between itself and the first annular step 90.

[0067] A male thread 96 provided on the outer periphery of a cylindrical holder 95 coaxially surrounding the guide tube 45C so as to hold the flange part 94 of the guide tube 45C between the holder 95 and the first annular step 90 is screwed into the threaded hole 89 of the body 13, and a bottomed tool engagement hole 97 is provided in the outer end of the holder 95, a tool used for rotating the holder 95 engaging with the tool engagement hole 97. By screwing the male thread 96 on the outer periphery of the holder 95 into the threaded hole 89 and tightening, the flange part 94 at the one end part of the guide tube 45C is held between the first annular step 90 and the holder 95 to thus fix the guide tube 45C to the body 13 and form an annular gap 98 between the inner periphery of the holder 95 and the outer periphery of the guide tube 45C, the annular gap 98 opening out-

wardly in the axial direction.

[0068] The bobbin 43B integrally has a cylindrical part 100, a first collar 101 protruding radially outwardly from a position that is spaced inwardly from one end, in the axial direction, of the cylindrical part 100, and a second collar 102 protruding radially outwardly from a position that is spaced inwardly from the other end, in the axial direction, of the cylindrical part 100, and the coil 44 is wound around the outer periphery of the cylindrical part 100 between the first and second collars 101 and 102.

[0069] The magnetic frame 48B is formed by joining to each other by swaging a first magnetic frame member 103 and a second magnetic frame member 104. The first magnetic frame member 103 integrally has a ring plate-shaped first end plate portion 103a that is disposed so as to be spaced outwardly in the axial direction of the first collar 101 of the bobbin 43B and abuts against one end, in the axial direction, of the cylindrical part 100, and a cylindrical magnetic flux transfer portion 103b that is connected to the inner periphery of the first end plate portion 103a and coaxially surrounds a part of the guide tube 45C that projects from the bobbin 43B toward the body 13 side.

[0070] The second magnetic frame member 104 is formed so as to integrally have a ring plate-shaped second end plate portion 104a that is disposed so as to be spaced outwardly in the axial direction of the second collar 102 of the bobbin 43B and abuts against the other end, in the axial direction, of the cylindrical part 100, an outer frame portion 104b that is connected to the outer periphery of the second end plate portion 104a, covers the bobbin 43B and the coil 44, and extends toward the outer periphery of the first end plate portion 103a, and a fitting tubular part 104c that is connected to the inner periphery of the second end plate portion 104a and is fitted into the other end part of the cylindrical part 100 of the bobbin 43B.

[0071] The outer frame portion 104b of the second magnetic frame member 104 is joined by swaging to the outer periphery of the first end plate portion 103a of the first magnetic frame member 103, thereby joining the first and second magnetic frame members 103 and 104 to each other to thus form the magnetic frame 48B. Moreover, a cutout part 105 is provided in the outer frame portion 104b of the second magnetic frame member 104, part of the first collar 101 of the bobbin 43B projecting via the cutout part 105, and the coupler part 50 is provided integrally with the cover portion 49B, terminal plates 67 extending outwardly from the first collar 101 going into the coupler part 50.

[0072] The fixed core 46B is formed from a magnetic metal into a rod shape having a circular cross section, and is secured to the guide tube 45C by welding, etc. in a state in which the inner end part thereof is fitted into the other end part of the guide tube 45C while the outer end thereof projects from the other end of the guide tube 45C, and part of this fixed core 46B is fitted into the fitting tubular part 104c of the second magnetic frame member 104.

[0073] The bobbin 43B, the coil 44 wound around the bobbin 43B, the magnetic frame 48A, and the cover portion 49B form a coil-side assembled unit 69B by assembling these 43B, 44, 48B, and 49B in advance, and this coil-side assembled unit 69B is fixed to the guide tube 45C.

[0074] Moreover, the cover portion 49B is formed so as to cover the bobbin 43B and the coil 44 and also cover that portion of the magnetic frame 48B that covers the bobbin 43B and the coil 44, and in Embodiment 3 the coil-side assembled unit 69B is formed by covering the bobbin 43B, the coil 44, and the magnetic frame 48B with the cover portion 49B except for part of the magnetic flux transfer portion 103b.

[0075] The cover portion 49B is formed so as to fill a section between the first collar 101 of the bobbin 43B and the first end plate portion 103a of the first magnetic frame member 103 and a section between the second collar 102 of the bobbin 43B and the second end plate portion 104a of the second magnetic frame member 104, and a through hole 106 is provided in the second end plate portion 104a, the through hole 106 guiding molten resin into the section between the second collar 102 and the second end plate portion 104a when forming the cover portion 49B. Furthermore, in order to fixedly determine the position, in the peripheral direction, of the bobbin 43B relative to the magnetic frame 48B, a positioning pin 107 projectingly provided on the first collar 101 of the bobbin 43B is inserted through a positioning hole 108 provided in the first end plate portion 103a of the first magnetic frame member 103 of the magnetic frame 48B.

[0076] Furthermore, of the first magnetic frame member 103 of the magnetic frame 48B, part of the magnetic flux transfer portion 103b projects from the cover portion 49B; in order to inhibit water that has infiltrated via a gap formed between the cover portion 49B and the outer periphery of the magnetic flux transfer portion 103b from flowing toward the coil 44 wound around the bobbin 43B, pluralities of annular labyrinth grooves 110, 111 are provided on a face, that faces the cover portion 49B, of the first end plate portion 103a of the first magnetic frame member 103 and an outer face, that faces the cover portion 49B, of the first collar 101 of the bobbin 43B.

[0077] Moreover, a hole 114 is formed in the cover portion 49B so that part of the second end plate portion 104a of the second magnetic frame member 104 of the magnetic frame 48B faces the exterior when pulling out the positioning pin for carrying out positioning of the magnetic frame 48B and the bobbin 43B wound around the coil 44 when carrying out molding; in order to inhibit water that has infiltrated via the hole 114 from flowing toward the coil 44 wound around the bobbin 43A, pluralities of annular labyrinth grooves 112, 113 are provided on a face, facing the cover portion 49B, of the second end plate portion 104a of the second magnetic frame member 104 and an outer face, facing the cover portion 49B, of the second collar 102 of the bobbin 43B.

[0078] The coil-side assembled unit 69B thus formed is fixed to the guide tube 45C by press fitting the cylindrical magnetic flux transfer portion 103b, which, while forming part of the magnetic frame 48B, coaxially surrounds a portion of the guide tube 45C that projects from the bobbin 43B toward the body 13 side, into the inner periphery of the holder 95 within the annular gap 98, which is formed between the holder 95 and the guide tube 45C.

[0079] In accordance with Embodiment 3, the guide tube 45C and the holder 95 forming the annular gap 98 between itself and the guide tube 45C are fixed to the body 13 by screwing into the threaded hole 89 of the body 13 the male thread 96 on the outer periphery of the cylindrical holder 95 holding the guide tube 45C between itself and the body 13, and the coil-side assembled unit 69B formed by assembling in advance the bobbin 43B, the coil 44, the magnetic frame 48B, and the cover portion 49B is fixed to the guide tube 45C by press fitting the cylindrical magnetic flux transfer portion 103b forming part of the magnetic frame 48B into the inner periphery of the holder 95 within the annular gap 98; it is therefore unnecessary to employ a special component for fixing or to carry out special machining when assembling the bobbin 43B, the coil 44, the cover portion 49B integrally having the coupler part 50, and the magnetic frame 48B onto the guide tube 45C, and it becomes possible to carry out assembly with enhanced workability by means of a structure having fewer components and low cost. Furthermore, the position of the coupler part 50 in the peripheral direction of the guide tube 45C can be set freely and easily only by determining it when press fitting the magnetic flux transfer portion 103b into the inner periphery of the holder 95, and the position of the coupler part 50 will not deviate from the set position.

[0080] Moreover, providing the magnetic flux transfer portion 103b enables the area of the magnetic path between the magnetic frame 48B and the plunger 47 to be increased, thereby increasing the attractive force of the fixed core 46B acting on the plunger 47. Furthermore, since the magnetic flux transfer portion 103b is inserted into the annular gap 98, any increase in the axial length of the electromagnetic cut-off valve 17B due to the magnetic flux transfer portion 103b being provided on the magnetic frame 48B can be suppressed; moreover, it is unnecessary to take into consideration deformation of the guide tube, into which the plunger 47 is fitted, due to the magnetic flux transfer portion 103b being press fitted into the inner periphery of the holder 95, and the slide gap between the guide tube 45C and the plunger 47 can be set small.

[0081] Furthermore, since the flange part 94 integrally provided with the end part, on the body 13 side, of the guide tube 45C and protruding in the radially outward direction is held between the annular step 90 of the body 13 and the holder 95, it is possible to easily form the annular gap 98 between the holder 95 and the guide tube 45.

[0082] Moreover, since the cover portion 49B of the coil-side assembled unit 69B is formed so as to cover the bobbin 43B and the coil 44 and also cover that portion of the magnetic frame 48B that covers the bobbin 43B and the coil 44, the mass productivity of the coil-side assembled unit 69B can be enhanced by making the bobbin 43B, the coil 44, the magnetic frame 48B, and the cover portion 49B into a unit, and since that portion of the magnetic frame 48B that covers the bobbin 43B and the coil 44 is covered by the cover portion 49B, it is possible to make the magnetic frame 48B resistant to rusting.

[0083] Moreover, part of the magnetic flux transfer portion 103b of the first magnetic frame member 103 of the magnetic frame 48B projects from the cover portion 49B; since the pluralities of annular labyrinth grooves 110, 111 are provided on the face, facing the cover portion 49B, of the first end plate portion 103a of the first magnetic frame member 103 and the outer face, facing the cover portion 49B, of the first collar 101 of the bobbin 43B, it is possible to inhibit water that has infiltrated through the gap formed between the cover portion 49B and the outer periphery of the magnetic flux transfer portion 103b from flowing toward the coil 44 wound around the bobbin 43B, and it becomes unnecessary for a seal member to be disposed between the first end plate portion 103a and the cover portion 49B and between the first collar 101 and the cover portion 49B, thereby contributing to a reduction in the number of components.

[0084] Furthermore, the hole 114, which is formed by pulling out the positioning pin, is formed in the cover portion 49B so that part of the second end plate portion 104a of the second magnetic frame member 104 faces the exterior; since the pluralities of annular labyrinth grooves 112, 113 are provided on the face, facing the cover portion 49B, of the second end plate portion 104a of the second magnetic frame member 104 and the outer face, facing the cover portion 49B, of the second collar 102 of the bobbin 43B, water that has infiltrated via the hole 114 can be inhibited from flowing toward the coil 44 wound around the bobbin 43B, and it is unnecessary for a seal member to be disposed between the second end plate portion 104a and the cover portion 49B and between the second collar 102 and the cover portion 49B, thus contributing to a reduction in the number of components.

[0085] As another embodiment of the present invention, a coil-side assembled unit 69B may be fixed to a guide tube 45C by press fitting a guide tube 45C or a fixed core 46B secured to the guide tube 45C into a magnetic frame 48B while inserting a cylindrical magnetic flux transfer portion 103b forming part of the magnetic frame 48B into an annular gap 98.

EMBODIMENT 4

[0086] Embodiment 4 of the present invention is explained by reference to FIG. 7 and FIG. 8; parts corresponding to those of Embodiment 3 explained by reference to FIG. 5 and FIG. 6 are denoted by the same ref-

erence numerals and symbols and are only illustrated, detailed explanation thereof being omitted.

[0087] First, in FIG. 7, this coil-side assembled unit 69C is used in place of the coil-side assembled unit 69B of Embodiment 3, and is formed from a bobbin 43B, a coil 44 wound around the bobbin 43B, a magnetic frame 48B, and a cover portion 49C.

[0088] Referring in addition to FIG. 8, the bobbin 43B, the coil 44 wound around the bobbin 43B, and the cover portion 49C covering the bobbin 43B and the coil 44 form a coil assembly 116, and the cover portion 49C is provided integrally with a coupler part 50.

[0089] The magnetic frame 48B is the same as the magnetic frame 48B of Embodiment 3 and is formed by joining to each other first and second magnetic frame members 103 and 104 covering the coil assembly 116 in cooperation, the first and second magnetic frame members 103 and 104 being joined to each other by swaging or press fitting (swaging in this embodiment).

[0090] In accordance with Embodiment 4, since the coil-side assembled unit 69C is formed by covering the coil assembly 116, which is formed by covering the bobbin 43B and the coil 44 by the cover portion 49C, with the first and second magnetic frame members 103 and 104 in cooperation, the first and second magnetic frame members 103 and 104 being joined to each other so as to form the magnetic frame 48B, compared with an arrangement in which part of the magnetic frames 48A and 48B is covered by the cover portions 49A and 49B, a mold for forming the cover portion 49C can have a simple structure.

[0091] In Embodiment 4 above, the magnetic frame 48B is formed from two magnetic frame members, that is, the first and second magnetic frame members 103 and 104, but a magnetic frame may be formed from three or more magnetic frame members that cover the coil assembly 116 in cooperation.

EMBODIMENT 5

[0092] Embodiment 5 of the present invention is explained by reference to FIG. 9; parts corresponding to those of each of the above-mentioned embodiments are denoted by the same reference numerals and symbols and are only illustrated, detailed explanation thereof being omitted.

[0093] This coil-side assembled unit 69D is used in place of the coil-side assembled unit 69B of Embodiment 3, and is formed from a bobbin 43C, a coil 44 wound around the bobbin 43C, a magnetic frame 48B, and a cover portion 49D.

[0094] The bobbin 43C integrally has a cylindrical part 117, a first collar 118 protruding radially outwardly from a position that is spaced inwardly from one end, in the axial direction, of the cylindrical part 117, and a second collar 119 protruding radially outwardly from a position that is spaced inwardly from the other end, in the axial direction, of the cylindrical part 117, and the coil 44 is wound around the outer periphery of the cylindrical part 117 between the first and second collars 118 and 119.

[0095] The magnetic frame 48B is the same as the magnetic frame 48B of Embodiment 3 and Embodiment 4, and is formed by joining to each other first and second magnetic frame members 103 and 104. The internal diameter of the cylindrical part 117 of the bobbin 43C is set larger than the internal diameter of a magnetic flux transfer portion 103b of the magnetic frame 48B and the external diameter of a fitting tubular part 104c.

[0096] The entirety of the bobbin 43C and the coil 44 wound around the bobbin 43C is thus covered by the cover portion 49D, and a cylindrical part 120 is formed on the cover portion 49D, the cylindrical part 120 covering the inner periphery of the cylindrical part 117 of the bobbin 43C and forming an inner periphery that is flush with the inner periphery of the magnetic flux transfer portion 103b of the magnetic frame 48B.

[0097] In accordance with Embodiment 5, since the entirety of the bobbin 43C and the coil 44 is covered by the cover portion 49D, it is possible to reliably inhibit water from infiltrating into the coil 44 side without a seal member such as an O ring being disposed between the bobbin 43C and the cover portion 49D.

EMBODIMENT 6

[0098] Embodiment 6 of the present invention is explained by reference to FIG. 10; parts corresponding to those of each of the above-mentioned embodiments are denoted by the same reference numerals and symbols and are only illustrated, detailed explanation thereof being omitted.

[0099] Coaxially provided in the body 13 are a communication hole 53 having its inner end communicating with a high-pressure chamber 28 (see Embodiment 1), a main valve chamber-forming hole 54 having a larger diameter than that of the communication hole 53 and being connected to the outer end of the communication hole 53, and a threaded hole 89 having a larger diameter than that of the main valve chamber-forming hole 54 and being connected to the outer end of the main valve chamber-forming hole 54. Furthermore, an annular step 122 facing outward in the axial direction is formed between the main valve chamber-forming hole 54 and the threaded hole 89, and a ring groove 93 is provided in the annular step 122, an O ring 92 being fitted into the ring groove 93.

[0100] A guide tube 45D is formed so as to have in one end part an annular recess 124 that is coaxially disposed radially inward of the threaded hole 89 and opens outwardly in the axial direction, and a fixed core 46B is secured to the other end of the guide tube 45D. Moreover, a male thread 123 is cut on the outer periphery of the one end part of the guide tube 45D, and a bottomed tool engagement hole 125 is provided in a portion of the one end part of the guide tube 45D that faces outward in the axial direction, a tool for rotating the guide tube 45D engaging with the tool engagement hole 125. By screwing

the male thread 123 into the threaded hole 89 and tightening it until the guide tube 45D abuts against the O ring 92, the guide tube 45D is fixed to the body 13.

[0101] A coil-side assembled unit 69B is fixed to the guide tube 45D by press fitting, into the guide tube 45D within the annular recess 124, the outer periphery of a cylindrical magnetic flux transfer portion 103b coaxially surrounding a portion of the guide tube 45D that projects from the bobbin 43B toward the body 13 side and forming part of the magnetic frame 48B.

[0102] In accordance with Embodiment 6 also, in the same manner as in Embodiment 3, providing the magnetic flux transfer portion 103b enables the area of the magnetic path between a magnetic frame 48B and a plunger 47 to be increased, thus increasing the attractive force of the fixed core 46B acting on the plunger 47, and since the magnetic flux transfer portion 103b is inserted into the annular recess 124, any increase in the axial length of the electromagnetic cut-off valve caused by providing the magnetic flux transfer portion 103b on the magnetic frame 48B can be suppressed.

[0103] As another embodiment of the present invention, the coil-side assembled unit 69B may be fixed to the guide tube 45D by press fitting the guide tube 45D or the fixed core 46B fixed to the guide tube 45D into the magnetic frame 48B while inserting the magnetic flux transfer portion 103b into the annular recess 124.

[0104] Modes for carrying out the present invention are explained above, but the present invention is not limited to the above-mentioned embodiments and may be modified in a variety of ways as long as the modifications do not depart from the spirit and scope thereof.

Claims

1. A solenoid device comprising a bobbin (43A), a coil (44) that is wound around the bobbin (43A), a guide tube (45A, 45B) that is made of a non-magnetic material, has one end part fixed to a body (13), and is inserted into the bobbin (43A), a fixed core (46A) that is fixed to the guide tube (45A, 45B) so as to block the other end of the guide tube (45A, 45B), a plunger (47) that is slidably fitted into the guide tube (45A, 45B) so as to oppose the fixed core (46A), a magnetic frame (48A) that covers at least the bobbin (43A) and the coil (44) and provides a magnetic connection between the fixed core (46A) and the plunger (47), and a cover portion (49A) that is made of a synthetic resin, covers the bobbin (43A) and the coil (44), and integrally has a coupler part (50) projecting outwardly from the magnetic frame (48A), **characterized in that** a male thread (63) provided on an outer periphery of the guide tube (45A) or a male thread (85) provided on an outer periphery of a cylindrical holder (84) holding the guide tube (45B) between the holder and the body (13) is screwed into a threaded hole (58) provided in the body (13) so as to fix the guide tube (45A, 45B) to the body (13), and a coil-side assembled unit (69A) formed by assembling in advance the bobbin (43A), the coil (44), the magnetic frame (48A) and the cover portion (49A) is fixed to the guide tube (45A, 45B) by press fitting the guide tube (45A, 45B) or the fixed core (46A) fixed to the guide tube (45A, 45B) into the magnetic frame (48A).

2. A solenoid device comprising a bobbin (43B, 43C), a coil (44) that is wound around the bobbin (43B, 43C), a guide tube (45C, 45D) that is made of a non-magnetic material, has one end part fixed to a body (13), and is inserted into the bobbin (43B, 43C), a fixed core (46B) that is fixed to the guide tube (45C, 45D) so as to block the other end of the guide tube (45C, 45D), a plunger (47) that is slidably fitted into the guide tube (45C, 45D) so as to oppose the fixed core (46B), a magnetic frame (48B) that covers at least the bobbin (43B, 43C) and the coil (44) and provides a magnetic connection between the fixed core (46B) and the plunger (47), and a cover portion (49B, 49C, 49D) that is made of a synthetic resin, covers the bobbin (43B, 43C) and the coil (44), and integrally has a coupler part (50) projecting outwardly from the magnetic frame (48B), **characterized in that** a threaded hole (89) is provided in the body (13), a male thread (96) provided on an outer periphery of a cylindrical holder (95) holding the guide tube (45C) between the holder and the body (13) while forming between the holder and an outer periphery of the guide tube (45C) an annular gap (98) opening outwardly in an axial direction or a male thread (123) provided on an outer periphery of the guide tube (45D) having an annular recess (124) coaxially disposed in a radially inward direction of the threaded hole (89) and opening outwardly in an axial direction is screwed into the threaded hole (89) so as to fix the guide tube (45C, 45D) to the body (13), and a coil-side assembled unit (69B, 69C, 69D) formed by assembling in advance the bobbin (43B, 43C), the coil (44), the magnetic frame (48B) and the cover portion (49B, 49C, 49D) is fixed to the guide tube (45C, 45D) by press fitting an outer periphery of a cylindrical magnetic flux transfer portion (103b) forming part of the magnetic frame (48B) while coaxially surrounding part of the guide tube (45C, 45D) that projects from the bobbin (43B) toward the body (13) into an inner periphery of the holder (95) within the annular gap (98) or press fitting the outer periphery of the magnetic flux transfer portion (103b) into the guide tube (45D) within the annular recess (124).

3. A solenoid device comprising a bobbin (43B, 43C), a coil (44) that is wound around the bobbin (43B, 43C), a guide tube (45C, 45D) that is made of a non-magnetic material, has one end part fixed to a body (13), and is inserted into the bobbin (43B, 43C), a fixed core (46B) that is fixed to the guide tube (45C,

45D) so as to block the other end of the guide tube (45C, 45D), a plunger (47) that is slidably fitted into the guide tube (45C, 45D) so as to oppose the fixed core (46B), a magnetic frame (48B) that covers at least the bobbin (43B, 43C) and the coil (44) and provides a magnetic connection between the fixed core (46B) and the plunger (47), and a cover portion (49B, 49C, 49D) that is made of a synthetic resin, covers the bobbin (43B, 43C) and the coil (44), and integrally has a coupler part (50) projecting outwardly from the magnetic frame (48B), **characterized in that** a threaded hole (89) is provided in the body (13), a male thread (96) provided on an outer periphery of a cylindrical holder (95) holding the guide tube (45C) between the holder and the body (13) while forming between the holder and an outer periphery of the guide tube (45C) an annular gap (98) opening outwardly in an axial direction or a male thread (123) provided on an outer periphery of the guide tube (45D) having an annular recess (124) coaxially disposed in a radially inward direction of the threaded hole (89) and opening outwardly in an axial direction is screwed into the threaded hole (89) so as to fix the guide tube (45C, 45D) to the body (13), and a coil-side assembled unit (69B, 69C, 69D) formed by assembling in advance the bobbin (43B, 43C), the coil (44), the magnetic frame (48B) and the cover portion (49B, 49C, 49D) is fixed to the guide tube (45C, 45D) by press fitting the guide tube (45C, 45D) or the fixed core (46B) fixed to the guide tube (45C, 45D) into the magnetic frame (48B) while inserting into the annular gap (98) or the annular recess (124) a cylindrical magnetic flux transfer portion (103b) forming part of the magnetic frame (48B) while coaxially surrounding part of the guide tube (45C, 45D) that projects from the bobbin (43B) toward the body (13).

4. The solenoid device according to Claim 2 or 3, wherein an annular step (90) that is disposed further inward in the axial direction than the threaded hole (89) is provided on the body (13) so as to face outward in the axial direction, and a flange part (94) sandwiched between the annular step (90) and the holder (95) is integrally provided with an end part, on the body (13) side, of the guide tube (45C) so as to protrude outwardly in the radial direction.

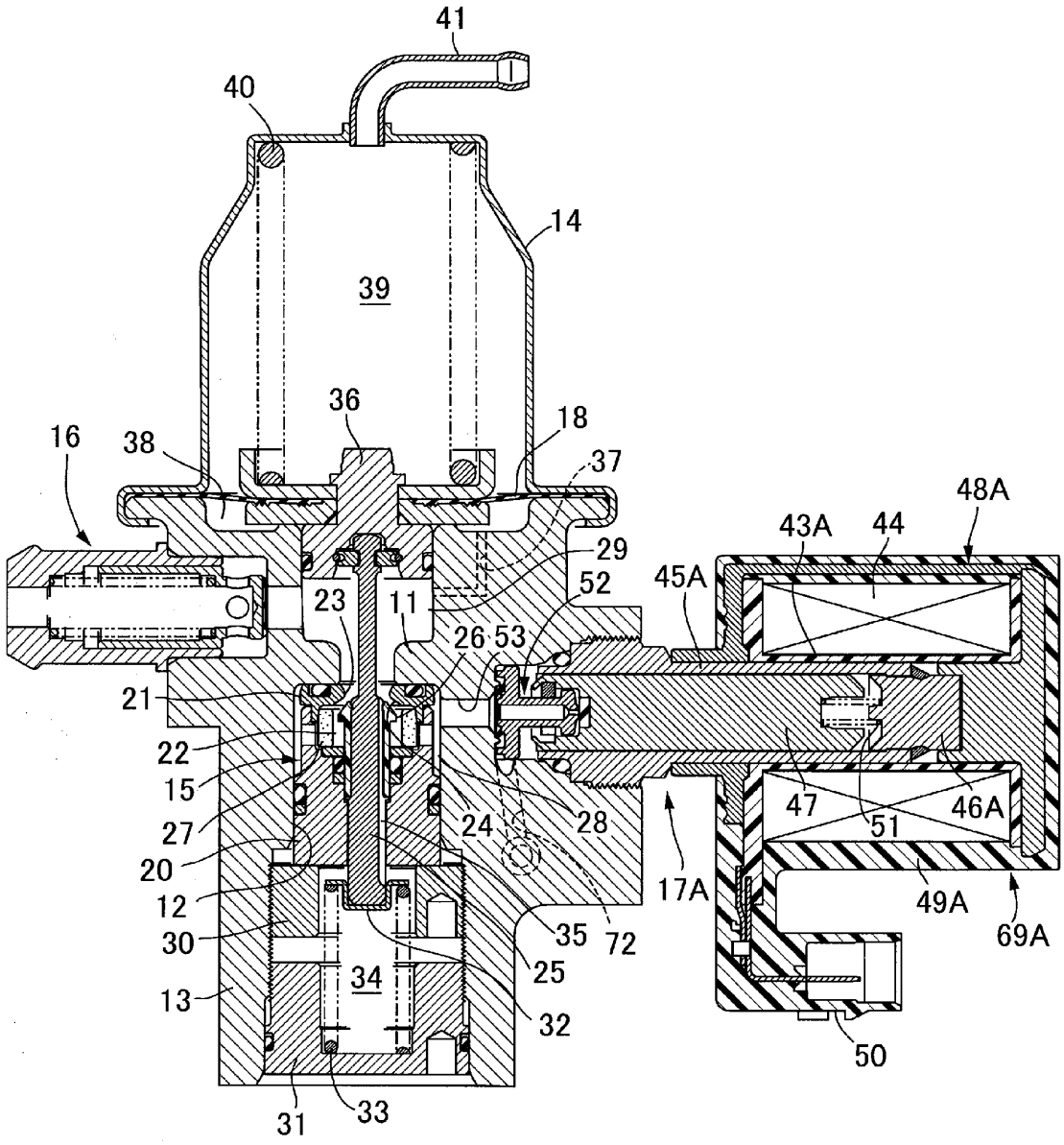
5. The solenoid device according to any one of Claims 1 to 4, wherein the cover portion (49A, 49B, 49C) of the coil-side assembled unit (69A, 69B, 69D) is formed so as to cover the bobbin (43A, 43B) and the coil (44) and also covers that part of the magnetic frame (48A, 48B) that covers the bobbin (43A, 43B, 43C) and the coil (44).

6. The solenoid device according to any one of Claims 1 to 4, wherein the coil-side assembled unit (69C) is formed from a coil assembly (116) that is formed by covering the bobbin (43B) and the coil (44) with a cover portion (49C) having the coupler part (50) formed integrally therewith, and the magnetic frame (48B) that is formed by joining to each other at least two magnetic frame members (103, 104) covering the coil assembly (116) in cooperation, said at least two magnetic frame members (103, 104) being joined to each other by means of swaging or press fitting.

7. The solenoid device according to any one of Claims 1 to 6, wherein a labyrinth groove (70, 110, 111, 112, 113) is provided on a face of the magnetic frame (48A, 48B) or the bobbin (43B, 43C) that faces the cover portion (49A, 49B, 49C).

8. The solenoid device according to any one of Claims 1 to 7, wherein the entirety of the bobbin (43C) and the coil (44) wound around the bobbin (43C) is covered by the cover portion (49D).

[Fig.1]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12
30
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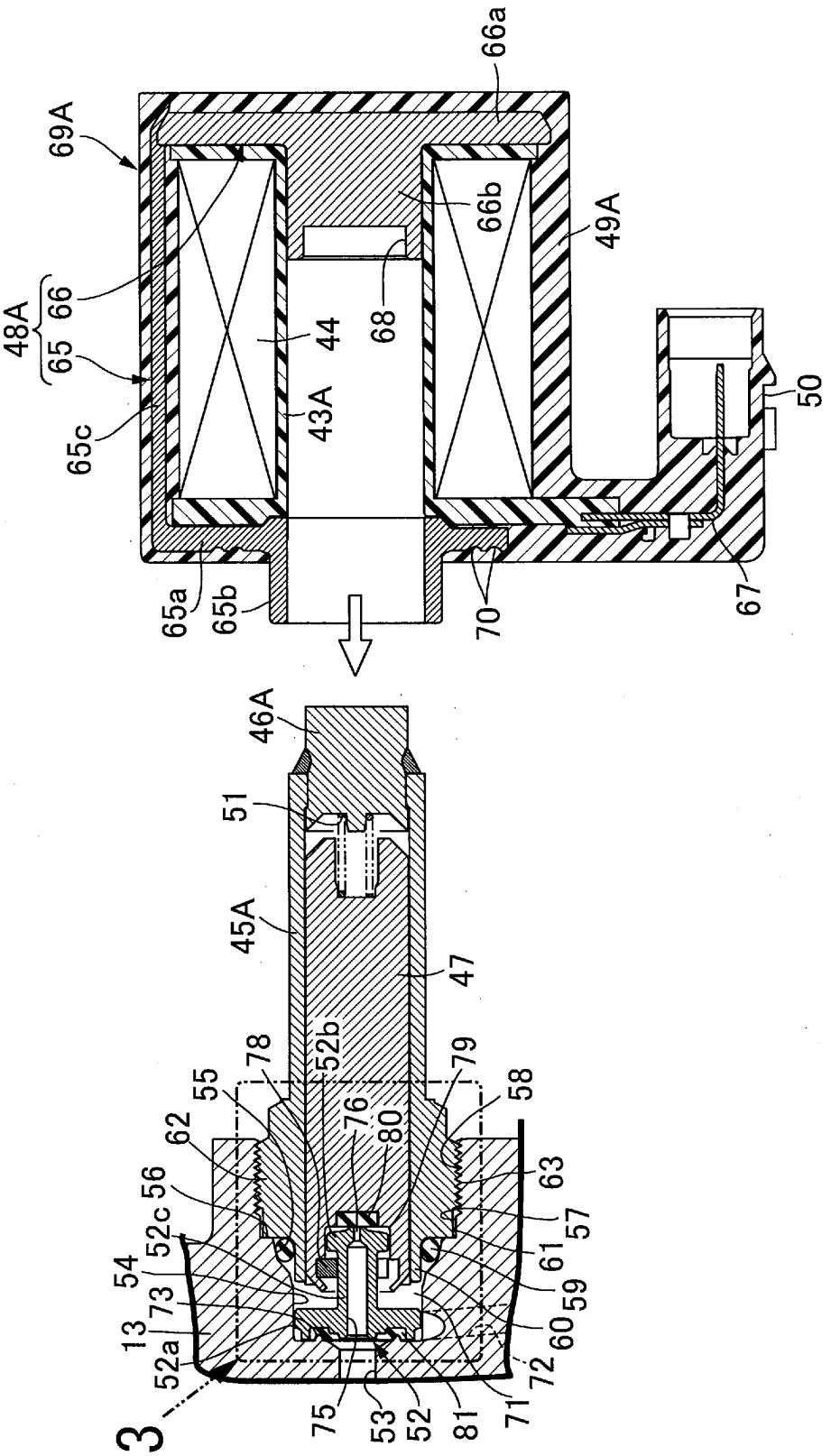
33

[Fig. 2]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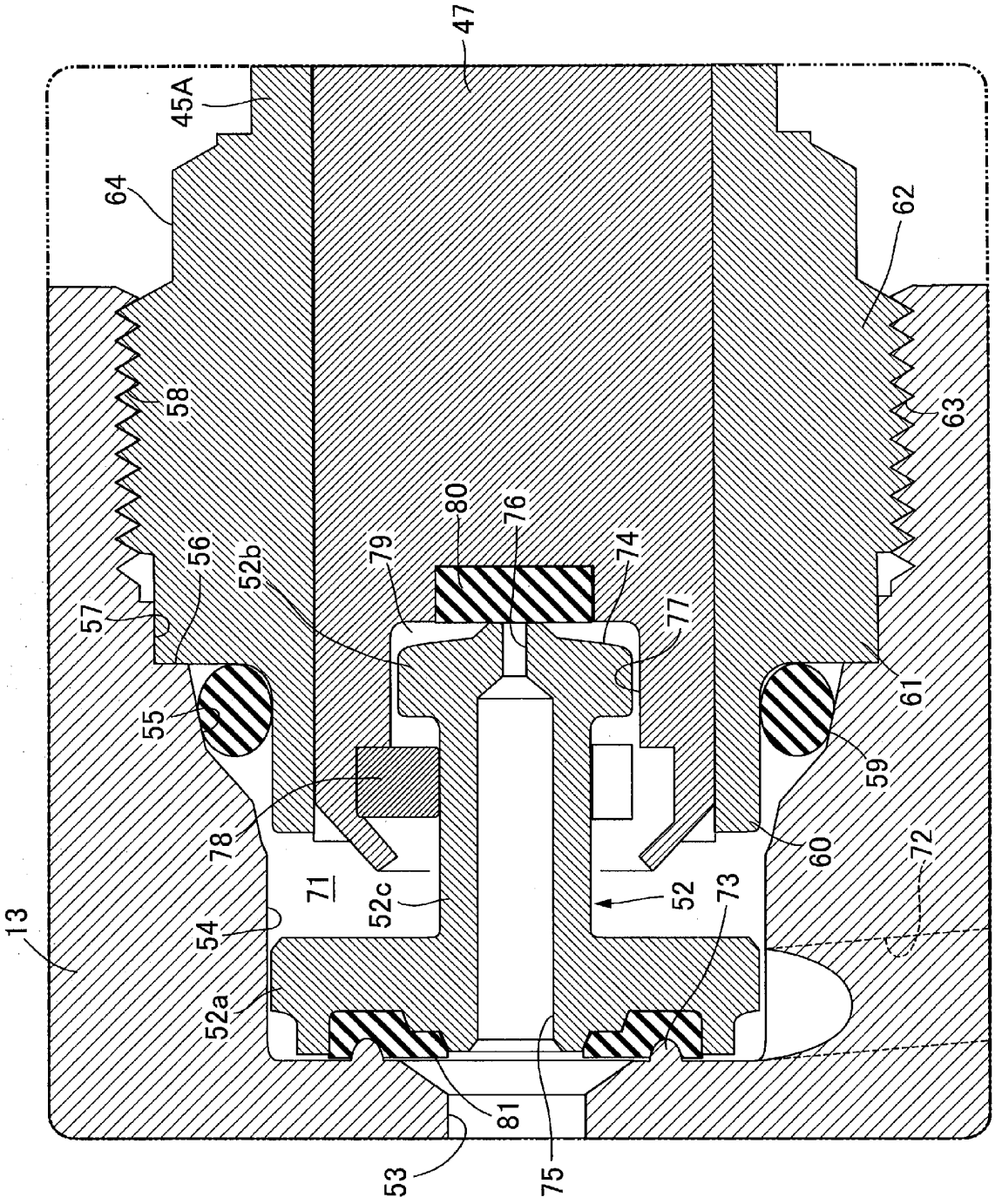
[Fig. 3]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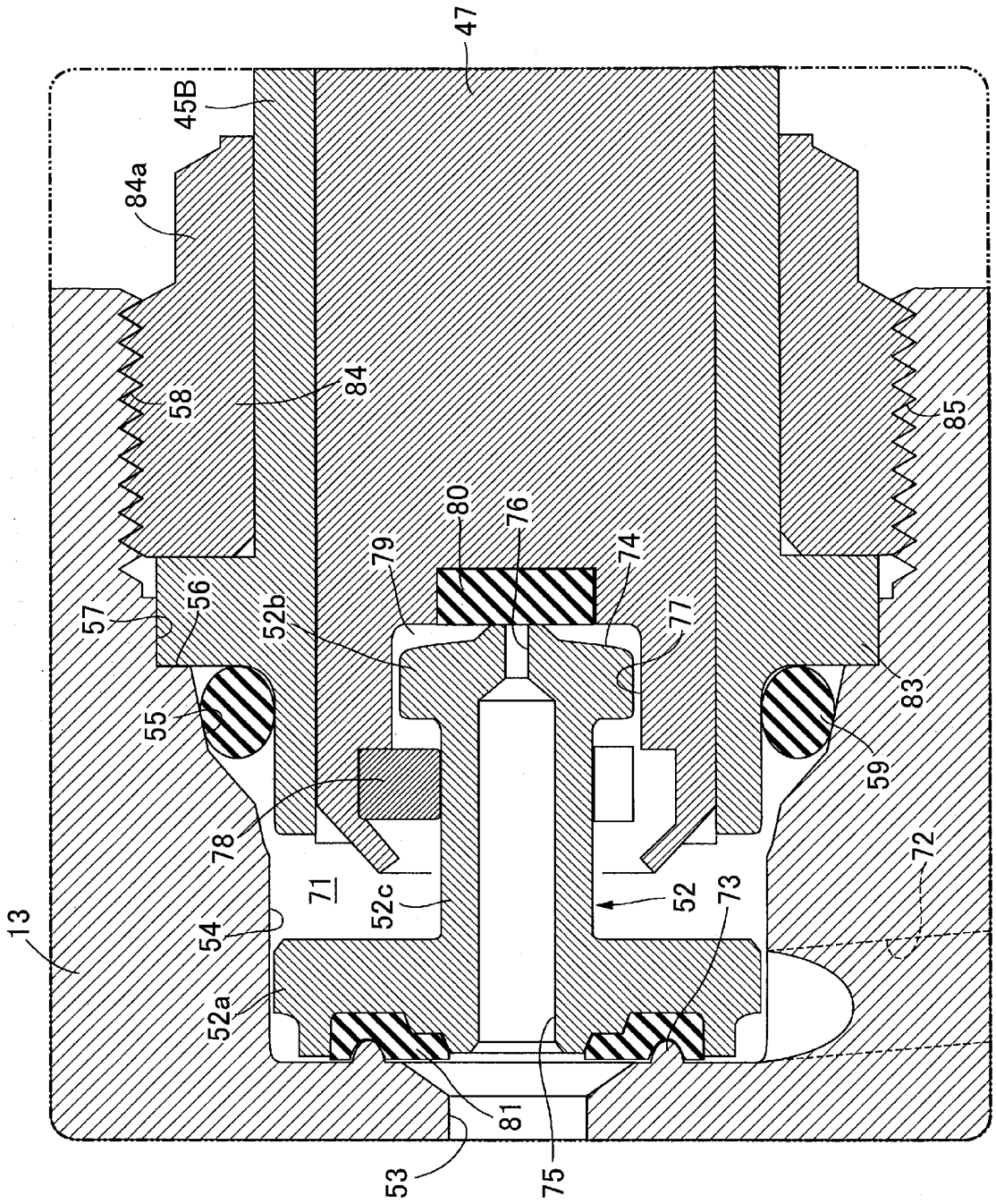
[Fig. 4]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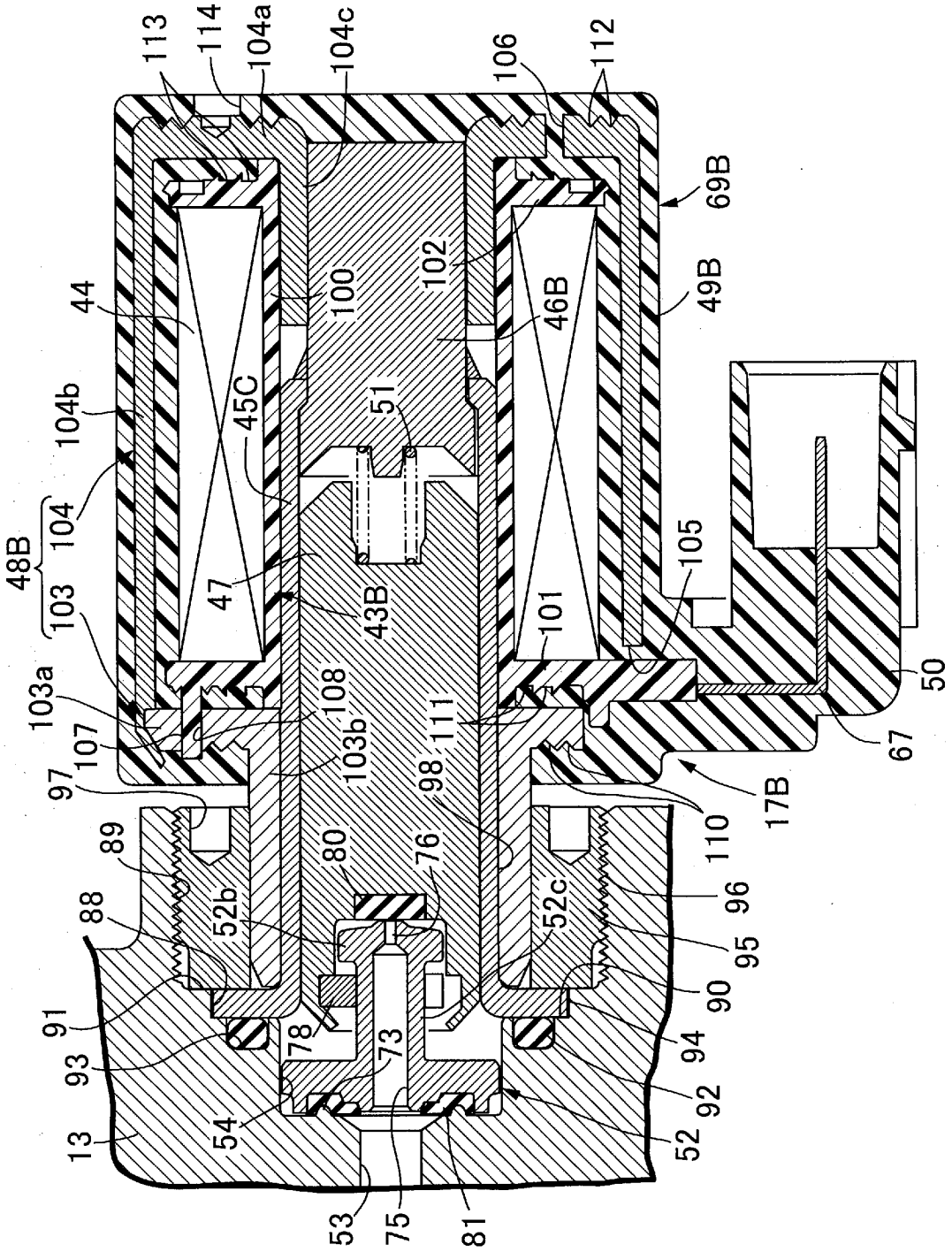
75

[Fig. 5]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43B
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103a
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103b
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107
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98
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17B
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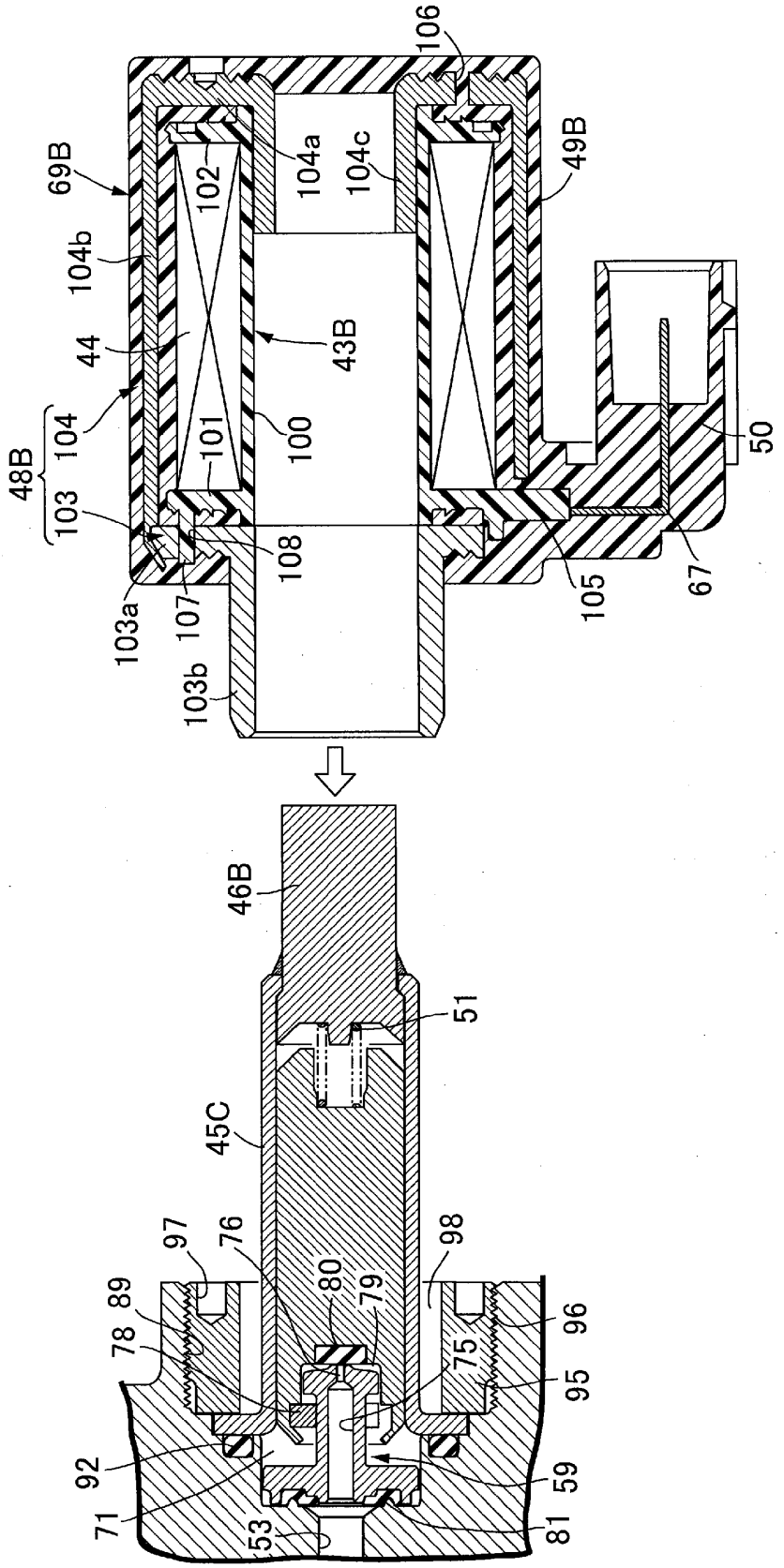
[Fig. 6]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103b
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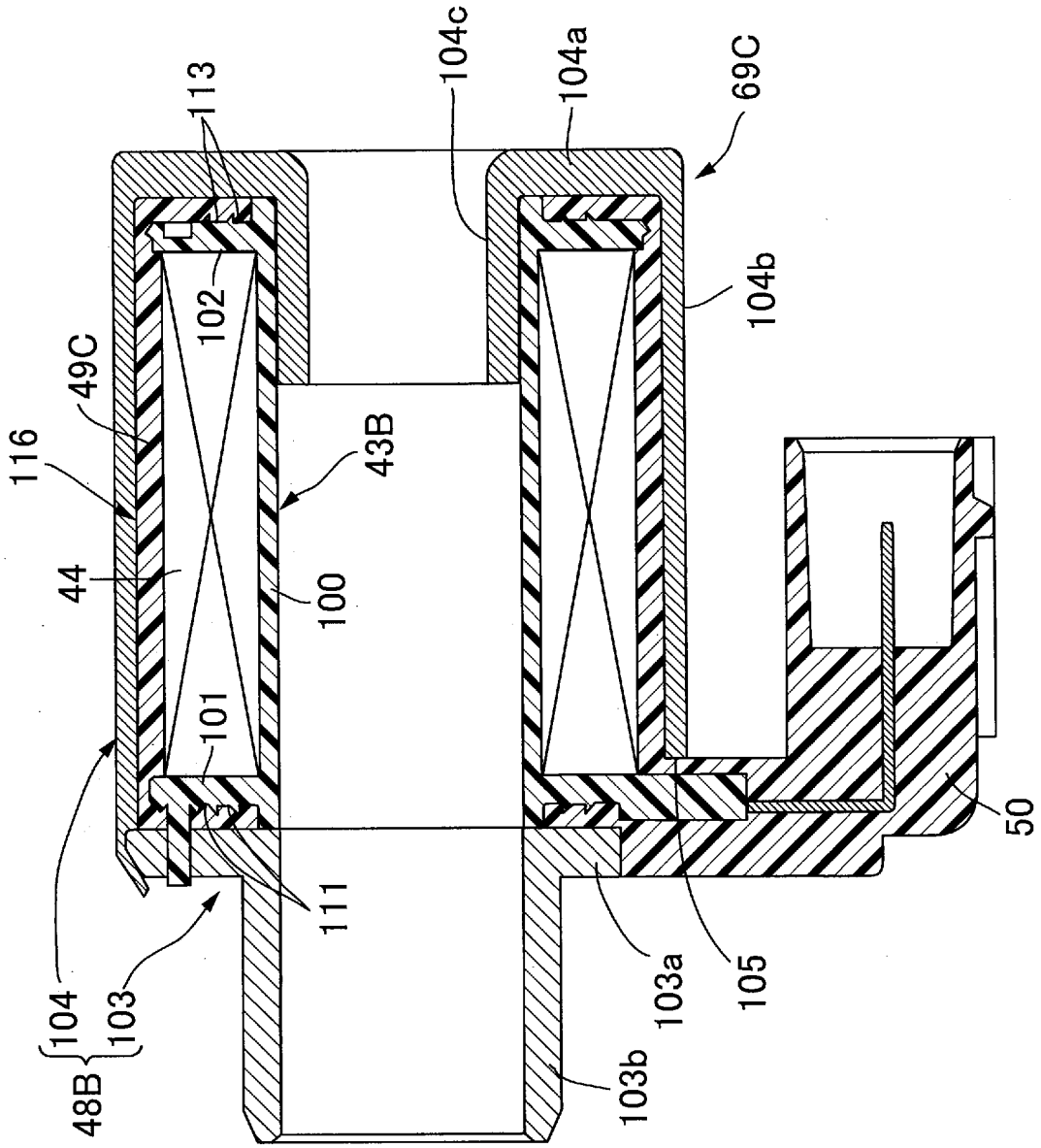
[Fig. 7]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48B
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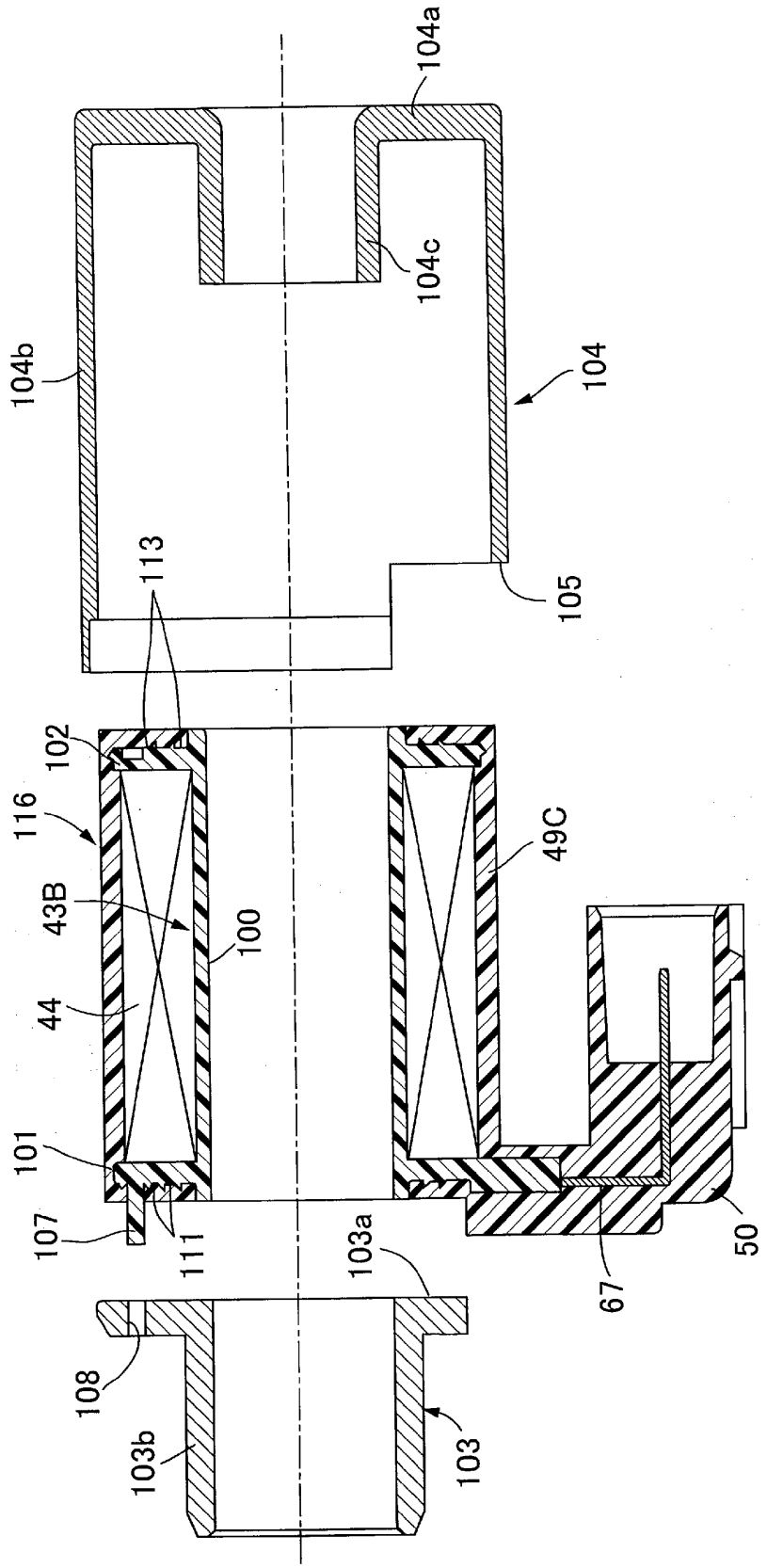
105
103b

[Fig. 8]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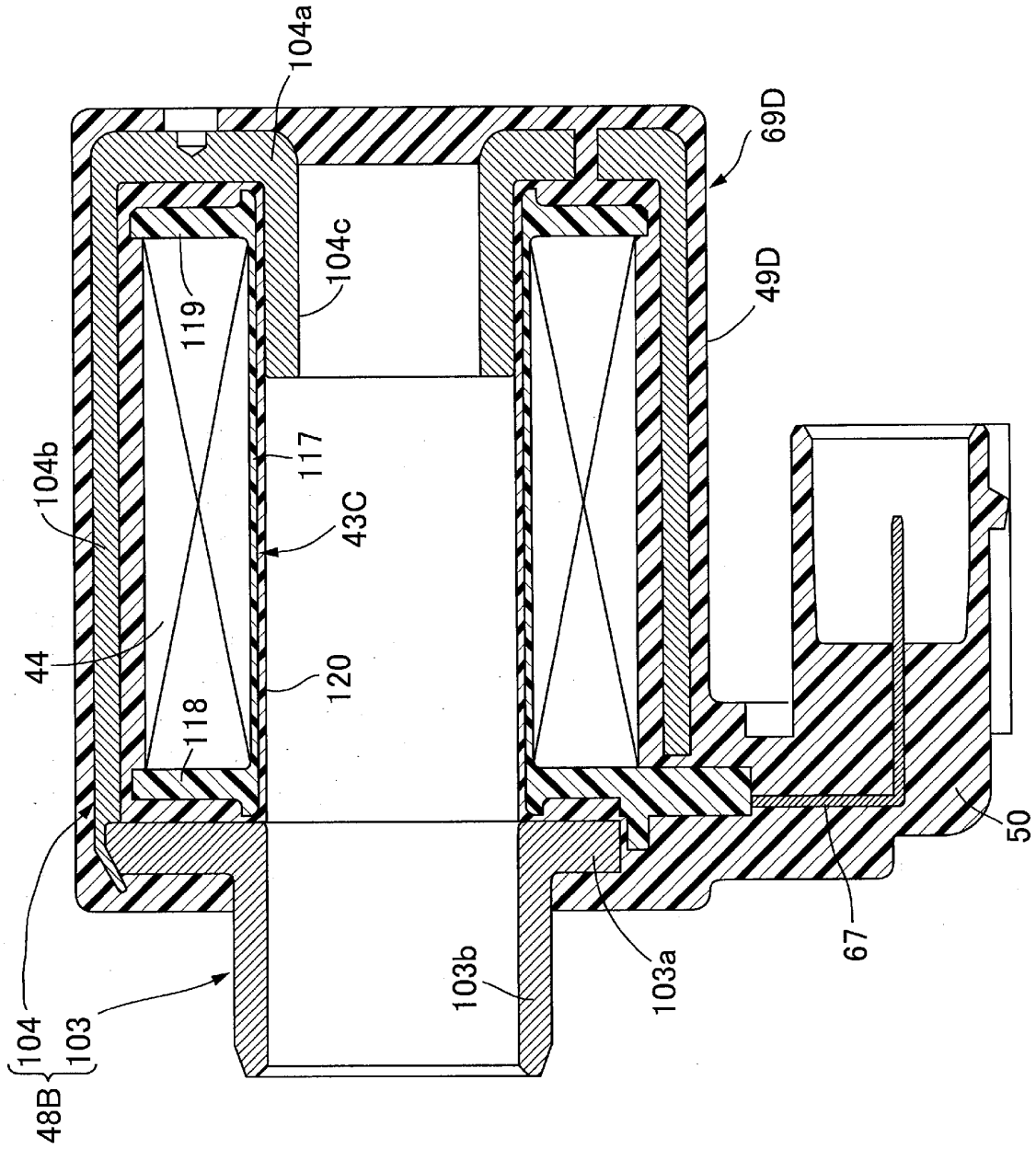
108
103b
103

[Fig. 9]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43C
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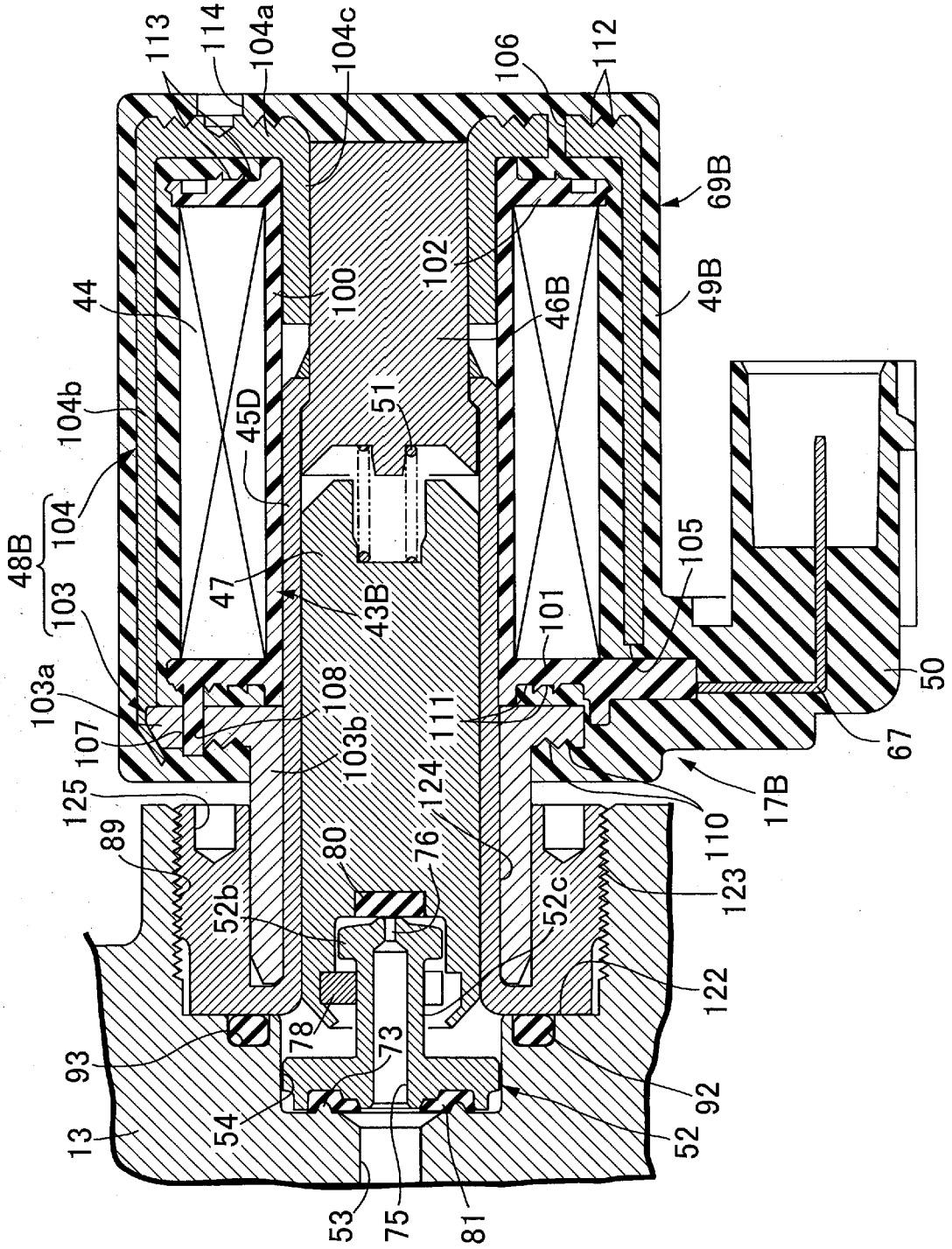
103b
103a
104
103
48B

[Fig. 10]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52c
122
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/072446

A. CLASSIFICATION OF SUBJECT MATTER
F16K31/06(2006.01)i, *H01F7/127*(2006.01)i, *H01F7/16*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16K31/06, H01F7/127, H01F7/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011
Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 11-270729 A (Kehin Corp.), 05 October 1999 (05.10.1999), fig. 6 (Family: none)	1-8
A	JP 59-089879 A (Honeywell Inc.), 24 May 1984 (24.05.1984), fig. 1 & US 4546955 A & EP 107445 A1	1-8
A	JP 04-151080 A (Nisshinbo Industries, Inc.), 25 May 1992 (25.05.1992), fig. 1 to 3 (Family: none)	1-8

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
06 January, 2011 (06.01.11)	18 January, 2011 (18.01.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/072446

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-193120 A (Toyota Motor Corp.), 14 July 2000 (14.07.2000), paragraphs [0022], [0023], [0032]; fig. 1 to 6 (Family: none)	1-8
A	JP 2002-213634 A (NIDEC Tosok Corp.), 31 July 2002 (31.07.2002), paragraph [0020]; fig. 1 (Family: none)	1-8
A	JP 11-186030 A (Toyooki Kogyo Co., Ltd.), 09 July 1999 (09.07.1999), paragraph [0008]; fig. 1 (Family: none)	5-8
A	JP 10-135034 A (Sanmei Electric Co., Ltd.), 22 May 1998 (22.05.1998), paragraph [0019]; fig. 1 (Family: none)	5-8
A	JP 04-257206 A (Zexel Corp.), 11 September 1992 (11.09.1992), fig. 1 to 3 (Family: none)	7,8
A	JP 07-037718 A (Dupon Kabushiki Kaisha), 07 February 1995 (07.02.1995), fig. 5 (Family: none)	7,8

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Patent documents cited in the description

- JP 11270729 A **[0003]**